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# Lahontan Reservoir Churchill and Lyon Counties, Nevada

National Eutrophication Survey, Las Vegas, Nev

Prepared for

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# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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# REPORT

ON

# LAHONTAN RESERVOIR

CHURCHILL AND LYON COUNTIES

NEVADA

EPA REGION IX

WORKING PAPER No. 807

WITH THE COOPERATION OF THE

NEVADA ENVIRONMENTAL PROTECTION SERVICE

AND THE

NEVADA NATIONAL GUARD

SEPTEMBER, 1977

# REPORT ON LAHONTAN RESERVOIR

## CHURCHILL AND LYON COUNTIES, NEVADA

## EPA REGION IX

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

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# FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the States.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Nevada State Environmental Protection Service for professional involvement, to the Nevada National Guard for conducting the tributary sampling phase of the Survey, and to those Nevada wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Department of Conservation and Natural Resources, Division of Environmental Protection, State Environmental Protection Service provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

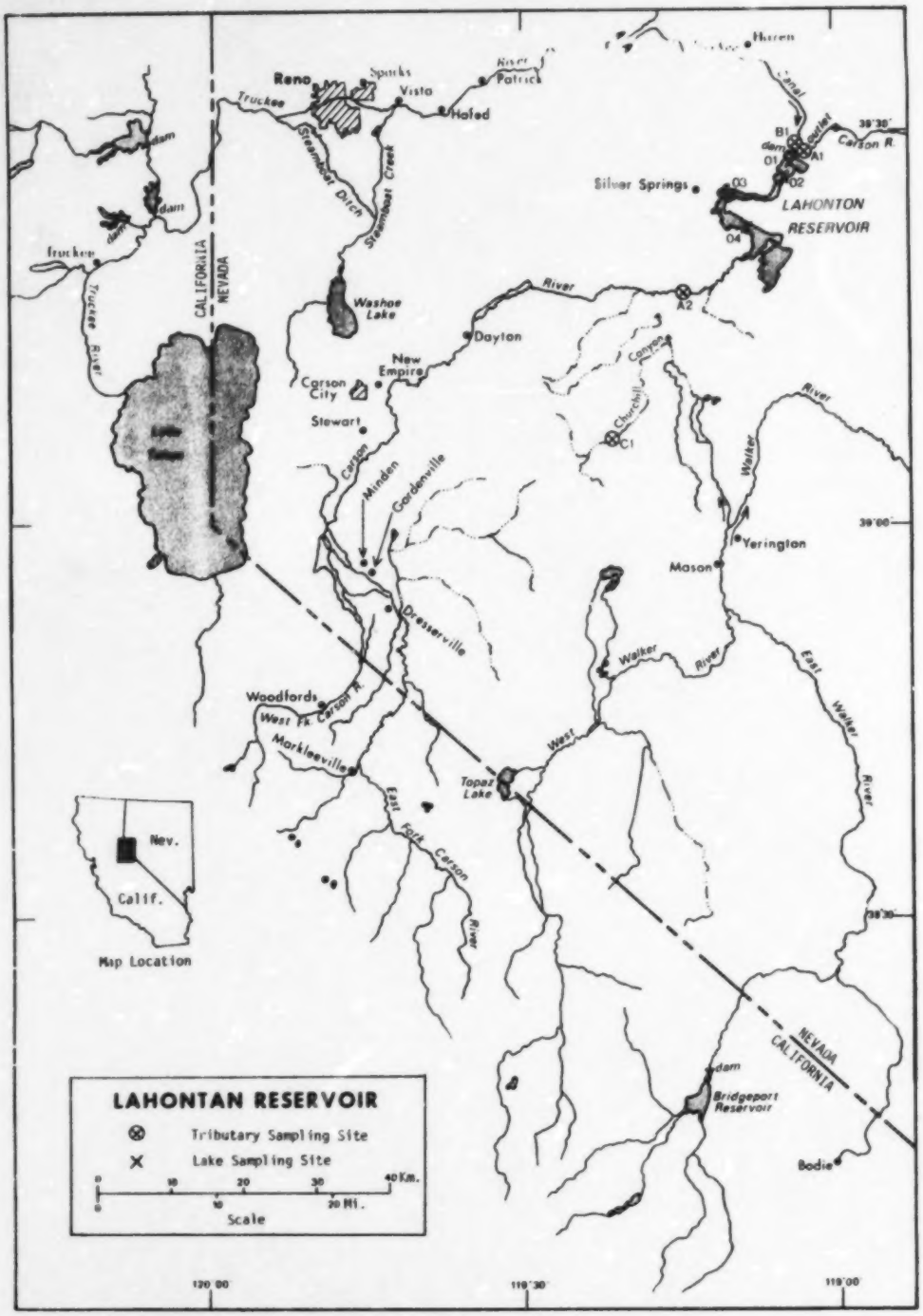
Major General Floyd L. Edsall, the Adjutant General of Nevada, and Project Officer Major Harold E. Roberts, who directed the volunteer efforts of the Nevada National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

## NATIONAL EUTROPHICATION SURVEY

## STUDY LAKES

## STATE OF NEVADA

| LAKE NAME | COUNTY |
|---|---|
| Lake Mead | Clark (Mohave in Arizona) |
| Lahontan Reservoir | Lyon, Churchill |
| Rye Patch Reservoir | Pershing |
| Lake Tahoe | Washoe, Carson City, Douglas (Placer, El Dorado in CA) |
| Topaz Reservoir | Douglas (Mono in CA) |
| Upper Pahranagat Lake | Lincoln |
| Washoe Lake | Washoe |
| Wildhorse Reservoir | Elko |
| Wilson Reservoir | Elko |
| Walker Lake | Mineral |



LAHONTAN RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Scale
Map Location
Nev.
Calif.
Reno
Sparks
Vista
Hofed
Patrick
Truckee
Steamboat Ditch
Steamboat Creek
Washoe Lake
Dayton
New Empire
Carson City
Stewart
Carson
Minden
Gardenville
Dresserville
Woodfords
West Fk. Carson R.
Markleeville
East Fork Carson River
Topaz Lake
West
Walker
River
East Walker River
Yerington
Mason
Churchill
Canyon
Silver Springs
LAHONTON RESERVOIR
Carson R.
Canal
outlet
dam
Bridgeport Reservoir
Bodie
CALIFORNIA
NEVADA
Truckee River
120°00'
119°30'
119°00'
39°30'
39°00'
38°30'

# REPORT ON LAHONTAN RESERVOIR, NEVADA

## STORET NO. 3202

## I. CONCLUSIONS

### A. Trophic Condition:*

Survey data indicate that Lahontan Reservoir is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of the lake.

Chlorophyll a values in the reservoir ranged from 1.3 µg/l to 14.7 µg/l with a mean of 4.6 µg/l. The potential for primary productivity as measured by algal assay control yields was high. Of the 10 Nevada lakes sampled in 1975, 2 had higher median total phosphorus levels (0.198 mg/l), none had higher median inorganic nitrogen values (0.350 mg/l), and 2 had higher median orthophosphorus levels (0.148 mg/l) than Lahontan Reservoir.

Survey limnologists did not report any problem algal blooms or macrophytes during their visits to the lake. However, it was noted that the lake was highly turbid on all sampling occasions, and low Secchi disc visibility (range 0.3 - 1.6 m) suggests that primary productivity in the lake may be light limited.

*See Appendix E.

B. Rate-Limiting Nutrient:

The algal assay results indicate that nitrogen was the primary limiting nutrient in Lahontan Reservoir during the sampling year. The mean inorganic nitrogen to orthophosphorus (N/P) ratios in the sampled waters of 2/1 or less on the three sampling dates further suggest primary limitation by nitrogen.

C. Nutrient Controllability:

1. Point Sources -

There were no known point sources directly impacting Lahontan Reservoir during the sampling year. However, there are a number of municipal sources that did not participate in the 1975 Survey and most of which are further upstream than 40 stream-km (25 miles) from the reservoir. Although not included in the lake nutrient budget on pp. 13-14 because of their distance away these plants probably do contribute some nutrients to the lake. These sources include: Minden-Gardnerville Sanitation District, Douglas County Sewer Improvement District #1, Incline Village General Improvement District, Stewart STP, State of Nevada Medium Security STP, and Carson City STP (F. Luchetti, personal communication). Further investigation is needed to access the actual impact of these facilities on Lahontan Reservoir.

The present phosphorus loading of 9.53 g $P/m^2/yr$ is over nine times that proposed by Vollenweider (1975) as "eutrophic".

However, Vollenweiner's model is probably not applicable to lakes in which epilimnetic light penetration is severely reduced by the presence of suspended materials in the water columns. In lakes of this nature, phytoplankton levels may not develop to potential as a result of light limitation.

2. Nonpoint sources -

The Carson River contributed 69.5% of the total phosphorus load to Lahontan Reservoir during the sampling year, the Truckee Canal was estimated to contribute 17.0% of the total, and minor tributaries and immediate drainage contributed an estimated 13.2%. The Carson River Basin Council of Governments (1974) reports that pollution problems in the surface waters of the Carson River above Lahontan Reservoir are severe with phosphorus levels exceeding the State water quality standards. Sources of nutrient enrichment in the basin include effluent exported from Lake Tahoe, agricultural runoff, municipal and industrial point source contributions and mining discharges. It should be also noted that estimations of annual nutrient loadings contributed by septic tanks around Lahontan Reservoir may have been underestimated in this report. Additional study to obtain a more accurate picture of the complete budget for this lake is recommended.

## II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by James B. Williams, Jr. (personal communication). Tributary flow data except for Truckee Canal (B-1) were provided by the Nevada District Office of the U.S. Geological Survey (USGS). Outlet drainage area inculdes the lake surface area. The difference between the Carson River drainage area plus the lake surface area versus the outlet drainage area is equal to the drainage of the Truckee River (4.325 $km^2$). Much of the Truckee is diverted to Lahontan Reservoir via the Truckee Canal; The USGS (L. Bohmer, personal communication) states that in 1975, 113,400 acre-ft of water flowed through the canal past Hazen. From this volumetric figure it can be calculated that the average annual flow for the canal in 1975 was 4.35 $m^3$/sec (153.69 cfs). Nutrient loadings to Lahontan Reservoir for the canal, based upon this estimated flow value, are included in the lake nutrient budget on pp. 13-14. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No.175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 19.69 $km^2$.
2. Mean depth: 6.7 meters.
3. Maximum depth: 31.7 meters.
4. Volume: 131.161 x $10^6$ $m^3$.
5. Mean hydraulic retention time: 91 days.

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

| Name | Drainage area ($km^2$) | Mean Flow ($m^3$/sec) |
|---|---|---|
| A-2 Carson River | 4,229.5 | 12.41 |
| B-1 Truckee Canal | --- | 4.35 |
| Minor tributaries and immediate drainage - | 801.3 | 0.20 |
| Total | 5,030.8 | 16.96 |

2. Outlet - A-1 Carson River 9,375.8 16.62

C. Precipitation:

1. Year of sampling: 8.4 cm.
2. Mean annual: 12.0 cm.

## III. LAKE WATER QUALITY SUMMARY

Lahontan Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from four stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 24.4 meters at Station 01, 21.3 meters at Station 02, 13.1 meters at Station 03, and 7.6 meters at Station 04. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

RESERVOIR
CODE 3202

# PHYSICAL AND CHEMICAL CHARACTERISTICS

| PARAMETER | ( 3/17/75 ) S*** = 4 N* | RANGE | MEDIAN | MAX DEPTH RANGE (METERS) | ( 7/ 9/75 ) S*** = 4 N* | RANGE | MEDIAN | MAX DEPTH RANGE (METERS) | ( 11/ 7/75 ) S*** = 4 N* | RANGE | MEDIAN | MAX DEPTH RANGE (METERS) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE (DEG CENT) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 5.8- 8.4 | 7.0 | 0.0- 1.5 | 8 | 20.0- 24.0 | 22.0 | 0.0- 1.5 | 7 | 11.7- 13.3 | 12.5 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 5.7- 8.0 | 6.7 | 4.6- 24.4 | 4 | 14.0- 17.0 | 15.3 | 7.6- 24.4 | 4 | 11.7- 12.9 | 12.3 | 0.0- 20.7 |
| DISSOLVED OXYGEN (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 10.0- 10.6 | 10.4 | 0.0- 1.5 | 7 | 6.8- 8.4 | 8.0 | 0.0- 1.5 | 7 | 8.2- 9.4 | 8.6 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 10.4- 10.4 | 10.4 | 4.6- 24.4 | 3 | 4.6- 5.8 | 5.2 | 7.6- 21.3 | 4 | 7.4- 9.4 | 8.4 | 0.0- 20.7 |
| CONDUCTIVITY (UMHOS) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 220.- 327. | 246. | 0.0- 1.5 | 8 | 7.- 20. | 14. | 0.0- 1.5 | 7 | 139.- 169. | 141. | 0.0- 1.5 |
| MAX DEPTH** | 4 | 217.- 327. | 246. | 4.6- 24.4 | 4 | 5.- 14. | 11. | 7.6- 24.4 | 4 | 137.- 169. | 163. | 0.0- 20.7 |
| PH (STANDARD UNITS) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 7.8- 8.7 | 8.1 | 0.0- 1.5 | 8 | 8.0- 8.7 | 8.4 | 0.0- 1.5 | 7 | 7.3- 7.8 | 7.7 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 8.0- 8.6 | 8.1 | 4.6- 24.4 | 3 | 7.5- 7.7 | 7.6 | 7.6- 21.3 | 4 | 7.6- 7.8 | 7.7 | 0.0- 20.7 |
| TOTAL ALKALINITY (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 88.- 123. | 104. | 0.0- 1.5 | 8 | 62.- 86. | 76. | 0.0- 1.5 | 7 | 73.- 90. | 85. | 0.0- 1.5 |
| MAX DEPTH** | 4 | 93.- 113. | 101. | 4.6- 24.4 | 3 | 54.- 75. | 68. | 7.6- 21.3 | 4 | 69.- 91. | 90. | 0.0- 20.7 |
| TOTAL P (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 0.183-0.223 | 0.212 | 0.0- 1.5 | 8 | 0.092-0.143 | 0.134 | 0.0- 1.5 | 7 | 0.181-0.220 | 0.196 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 0.188-0.231 | 0.212 | 4.6- 24.4 | 3 | 0.167-0.290 | 0.220 | 7.6- 21.3 | 4 | 0.189-0.264 | 0.212 | 0.0- 20.7 |
| DISSOLVED ORTHO P (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 0.126-0.216 | 0.186 | 0.0- 1.5 | 8 | 0.068-0.096 | 0.089 | 0.0- 1.5 | 7 | 0.120-0.157 | 0.149 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 0.121-0.198 | 0.174 | 4.6- 24.4 | 3 | 0.112-0.161 | 0.119 | 7.6- 21.3 | 4 | 0.120-0.160 | 0.142 | 0.0- 20.7 |
| NO2+NO3 (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 0.040-0.600 | 0.490 | 0.0- 1.5 | 8 | 0.020-0.050 | 0.025 | 0.0- 1.5 | 7 | 0.120-0.360 | 0.340 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 0.080-0.600 | 0.480 | 4.6- 24.4 | 3 | 0.130-0.190 | 0.140 | 7.6- 21.3 | 4 | 0.120-0.360 | 0.360 | 0.0- 20.7 |
| AMMONIA (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 0.020-0.030 | 0.020 | 0.0- 1.5 | 8 | 0.030-0.070 | 0.040 | 0.0- 1.5 | 7 | 0.020-0.020 | 0.020 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 0.020-0.030 | 0.030 | 4.6- 24.4 | 3 | 0.030-0.080 | 0.060 | 7.6- 21.3 | 4 | 0.020-0.040 | 0.020 | 0.0- 20.7 |
| KJELDAHL N (MG/L) | | | | | | | | | | | | |
| 0.-1.5 M DEPTH | 8 | 0.200-0.400 | 0.200 | 0.0- 1.5 | 8 | 0.300-0.400 | 0.300 | 0.0- 1.5 | 7 | 0.200-0.400 | 0.200 | 0.0- 1.5 |
| MAX DEPTH** | 4 | 0.200-0.300 | 0.200 | 4.6- 24.4 | 3 | 0.200-0.500 | 0.300 | 7.6- 21.3 | 4 | 0.200-0.400 | 0.200 | 0.0- 20.7 |
| SECCHI DISC (METERS) | 4 | 0.5- 0.8 | 0.7 | | 4 | 0.7- 1.6 | 0.9 | | 4 | 0.3- 0.6 | 0.3 | |

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

| Sampling Date | Dominant Genera | Algal Units Per ml |
|---|---|---|
| 03/17/75 | 1. Centric diatom | 684 |
| | 2. Nitzschia | 650 |
| | 3. Chroomonas? | 308 |
| | 4. Chlamydomonas | 171 |
| | 5. Dactylococcopsis | 68 |
| | Other genera | 103 |
| | Total | 1,984 |
| 07/09/75 | 1. Fragilaria | 3,646 |
| | 2. Chroomonas? | 413 |
| | 3. Melosira | 413 |
| | 4. Asterionella | 69 |
| | 5. Schroederia | 69 |
| | Other genera | --- |
| | Total | 4,610 |
| 11/07/75 | 1. Nitzschia | 316 |
| | 2. Centric diatom | 158 |
| | 3. Chroomonas? | 158 |
| | 4. Navicula | 158 |
| | 5. Melosira | 105 |
| | Other genera | 264 |
| | Total | 1,159 |

2. **Chlorophyll a -**

| Sampling Date | Station Number | Chlorophyll a (µg/l) |
|---|---|---|
| 03/17/75 | 01 | 2.7 |
| | 02 | 2.5 |
| | 03 | 4.7 |
| | 04 | 14.7 |
| 07/09/75 | 01 | 5.1 |
| | 02 | 6.8 |
| | 03 | 3.0 |
| | 04 | 4.2 |
| 11/07/75 | 01 | 1.7 |
| | 02 | 1.3 |
| | 03 | 2.2 |
| | 04 | 6.4 |

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

| Spike (mg/l) | Ortho P Conc. (mg/l) | Inorganic N Conc. (mg/l) | Maximum Yield (mg/l-dry wt.) |
|---|---|---|---|
| a. 03/17/75 | | | |
| Control | 0.155 | 0.360 | 10.6 |
| 0.05 P | 0.205 | 0.360 | 10.3 |
| 0.05 P + 1.0 N | 0.205 | 1.360 | 32.3 |
| 1.00 N | 0.155 | 1.360 | 31.0 |
| b. 11/07/75 | | | |
| Control | 0.135 | 0.255 | 8.4 |
| 0.05 P | 0.185 | 0.255 | 8.6 |
| 0.05 P + 1.0 N | 0.185 | 1.255 | 24.1 |
| 1.00 N | 0.135 | 1.255 | 24.3 |

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum*, indicate that the potential for primary productivity was high during both sample collection times (03/17/75, 11/07/75).

The addition of nitrogen alone and in combination with phosphorus produced a significant increase in yield over that of the control indicating nitrogen limitation. Spikes of only phosphorus did not stimulate growth significantly beyond control yields.

The mean N/P ratios in the lake data were 2/1 or less on the three sampling occasions also suggesting primary limitation by nitrogen (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

*For further information regarding the algal assay test procedure and selection of test organisms, see U.S. EPA (1971).

## IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Nevada National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of May and June when two samples were collected. Sampling was begun November 1974, and was completed in November 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nevada District Office of the USGS for the tributary sites except for Truckee Canal (B-1), nearest the lake.

In this report, nutrient loads for sampled tributaries, except Truckee Canal (B-1), were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any. Nutrient loads for the Truckee Canal were calculated by multiplying the average annual flow times the respective mean total phosphorus and mean total nitrogen ($NO_2$ - $NO_3$ + Kjel) levels in the canal.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in kg/km$^2$/year, in Carson River at Station A-2 and multiplying the means by the ZZ area in km$^2$.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

| Source | kg P/yr | % of total |
|---|---|---|
| a. Tributaries (nonpoint load) - | | |
| A-2 Carson River | 130,470 | 69.5 |
| B-1 Truckee Canal | 31,965 | 17.0 |
| b. Minor tributaries and immediate drainage (nonpoint load) - | 24,840 | 13.2 |
| c. Known municipal STP's - None | | |
| d. Septic tanks* - | 5 | <0.1 |
| e. Known industrial - None | | |
| f. Direct precipitation** - | 345 | 0.2 |
| Total | 187,625 | 100.0% |

2. Outputs - A-1 Carson River 97,485

3. Net annual P accumulation - 90,140

*Estimate based on 3 campgrounds.
**Estimated (See NES Working Paper No.175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

| Source | kg N/yr | % of total |
|---|---|---|
| a. Tributaries (nonpoint load) - | | |
| A-2 Carson River | 548,245 | 64.2 |
| B-1 Truckee Canal | 180,530 | 21.1 |
| b. Minor tributaries and immediate drainage (nonpoint load) - | 104,170 | 12.2 |
| c. Known municipal STP's - None | | |
| d. Septic tanks* - | 210 | <0.1 |
| e. Known industrial - None | | |
| f. Direct precipitation** - | 21,255 | 2.5 |
| Total | 854,410 | 100.0% |

2. Outputs - A-1 Carson River 749,840

3. Net annual N accumulation - 104,570

*Estimate based on 3 campgrounds.
**Estimated (See NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

| Tributary | kg P/km$^2$/yr | kg N/km$^2$/yr |
|---|---|---|
| Carson River | 31 | 130 |

E. Mean Nutrient Concentrations in Ungaged Streams:

| Tributary | Mean Total P (mg/l) | Mean Total N (mg/l) |
|---|---|---|
| B-1 Truckee Canal | 0.233 | 1.316 |
| C-1 Unnamed Creek | 0.438 | 2.500 |

F. **Yearly Loadings:** In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

| | Total Yearly Phosphorus Loading ($g/m^2/yr$) |
|---|---|
| Estimated loading for Lahontan Reservoir | 9.53 |
| Vollenweider's "eutrophic" loading | 1.00 |
| Vollenweider's "oligotrophic" loading | 0.50 |

## V. LITERATURE REVIEWED

Bohmer, L. 1977. Personal communication (flow for Truckee Canal). U.S. Geological Survey, Carson City, Nevada.

Carson River Basin Council of Governments. 1974. Regional Water Quality Plan, Phase I, Existing Conditions, Carson River Basin. Carson City, Nevada.

Luchetti, F. 1977. Personal communication (sewage treatment plants). Nevada Environmental Protection Service, Carson City, Nevada.

U.S. Environmental Protection Agency. 1971. Algal Assay Procedure Bottle Test. National Eutrophication Program, Corvallis, Oregon.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

Williams, James B., Jr. 1974. Personal communication (lake morphometry). Department of Human Resources, Carson City, Nevada.

# VI. APPENDICES

## APPENDIX A

## CONVERSION FACTORS

## CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x $8.107 \times 10^{-4}$ = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

# APPENDIX B

## TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEVADA 1/21/77

LAKE CODE 3202 LAHONTAN RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 9375.8

| TRIBUTARY | SUB-DRAINAGE AREA(SQ KM) | NORMALIZED FLOWS(CMS) JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ME |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3202A1 | 9375.8 | 5.64 | 5.35 | 10.76 | 22.43 | 27.67 | 28.32 | 28.60 | 25.03 | 19.65 | 11.64 | 7.11 | 6.57 | 16.6 |
| 3202A2 | 4229.5 | 12.74 | 13.59 | 12.46 | 17.27 | 36.53 | 32.56 | 7.08 | 1.13 | 0.57 | 1.70 | 3.96 | 9.63 | 12.4 |
| 32027Z | 821.0 | 0.680 | 0.227 | 0.934 | 0.227 | 0.057 | 0.142 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.142 | 0.20 |

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 9375.8 TOTAL FLOW IN = 151.64
SUM OF SUB-DRAINAGE AREAS = 5050.5 TOTAL FLOW OUT = 198.76

NOTE *** 1670 SQ. MI. DR. AREA IN TRUCKEE R. WHICH PART OF H2O IS DIVERTED TO RES

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|---|---|---|---|---|---|---|---|---|---|
| 3202A1 | 11 | 74 | 1.065 | 23 | 0.142 | | | | |
| | 12 | 74 | 0.127 | 19 | 0.127 | | | | |
| | 1 | 75 | 0.102 | 11 | 0.108 | | | | |
| | 2 | 75 | 0.082 | 2 | 0.082 | | | | |
| | 3 | 75 | 5.862 | 8 | 0.082 | | | | |
| | 4 | 75 | 24.239 | 4 | 16.565 | | | | |
| | 5 | 75 | 26.278 | 17 | 28.600 | 28 | 27.439 | | |
| | 6 | 75 | 33.414 | 6 | 32.281 | 22 | 26.505 | | |
| | 7 | 75 | 29.450 | 12 | 28.883 | | | | |
| | 8 | 75 | 25.089 | 10 | 26.391 | | | | |
| | 9 | 75 | 20.020 | 13 | 15.206 | | | | |
| | 10 | 75 | 13.139 | | | | | | |
| 3202A2 | 11 | 74 | 4.559 | 23 | 5.069 | | | | |
| | 12 | 74 | 4.616 | 19 | 4.361 | | | | |
| | 1 | 75 | 4.559 | 11 | 5.663 | | | | |
| | 2 | 75 | 6.909 | 2 | 4.191 | | | | |
| | 3 | 75 | 9.968 | 8 | 7.136 | | | | |
| | 4 | 75 | 10.024 | 4 | 9.684 | | | | |
| | 5 | 75 | 42.475 | 17 | 48.988 | 28 | 74.473 | | |
| | 6 | 75 | 56.634 | 6 | 79.287 | 22 | 30.016 | | |
| | 7 | 75 | 8.495 | 12 | 12.346 | | | | |
| | 8 | 75 | 0.708 | 10 | 0.170 | | | | |
| | 9 | 75 | 0.736 | 13 | 0.793 | | | | |
| | 10 | 75 | 3.936 | | | | | | |

# APPENDIX C

# PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320201
39 27 25.0 119 04 06.0 3
LAHONTAN RESERVOIR
32001 NEVADA
150191

/TYPA/AMBNT/LAKE

11EPALES 04001002
0087 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/03/17 | 10 35 | 0000 | 5.9 | 10.6 | 33 | 225 | 7.90 | 97 | 0.030 | 0.200 | 0.600 | 0.204 |
| | 10 35 | 0005 | 5.8 | 10.4 | | 221 | 7.85 | 103 | 0.020 | 0.200K | 0.600 | 0.216 |
| | 10 35 | 0015 | 5.9 | 10.6 | | 221 | 7.95 | 88 | 0.020 | 0.200K | 0.590 | 0.193 |
| | 10 35 | 0035 | 5.9 | 10.4 | | 223 | 8.05 | 98 | 0.030 | 0.200K | 0.600 | 0.214 |
| | 10 35 | 0055 | 5.8 | 10.4 | | 220 | 8.10 | 89 | 0.020 | 0.200K | 0.590 | 0.189 |
| | 10 35 | 0080 | 5.7 | 10.4 | | 217 | 8.10 | 96 | 0.020 | 0.200K | 0.600 | 0.187 |
| 75/07/09 | 11 30 | 0000 | 22.0 | 8.0 | 64 | 20 | 8.70 | 84 | 0.040 | 0.400 | 0.020K | 0.068 |
| | 11 30 | 0005 | 21.0 | 8.0 | | 20 | 8.70 | 86 | 0.030 | 0.400 | 0.020K | 0.076 |
| | 11 30 | 0015 | 20.0 | | | 20 | 8.70 | 85 | 0.020 | 0.400 | 0.020K | 0.080 |
| | 11 30 | 0035 | 17.0 | | | 18 | 8.00 | 85 | 0.040 | 0.300 | 0.080 | 0.099 |
| | 11 30 | 0055 | 16.0 | 5.6 | | 16 | 7.80 | 85 | 0.040 | 0.300 | 0.140 | 0.114 |
| | 11 30 | 0080 | 14.0 | | | 14 | | | | | | |
| 75/11/07 | 09 50 | 0000 | 12.6 | 8.6 | 24 | 139 | 7.30 | 76 | 0.070 | 0.400 | 0.350 | 0.156 |
| | 09 50 | 0005 | 12.5 | 8.6 | | 139 | 7.50 | 73 | 0.020 | 0.300 | 0.350 | 0.157 |
| | 09 50 | 0015 | 12.5 | 8.6 | | 137 | 7.60 | 71 | 0.030 | 0.300 | 0.350 | 0.156 |
| | 09 50 | 0035 | 12.6 | 8.6 | | 137 | 7.65 | 68 | 0.030 | 0.200 | 0.350 | 0.163 |
| | 09 50 | 0068 | 12.5 | 8.6 | | 137 | 7.70 | 69 | 0.040 | 0.200 | 0.360 | 0.160 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/03/17 | 10 35 | 0000 | 0.216 | 2.7 | |
| | 10 35 | 0001 | | | 50.0 |
| | 10 35 | 0005 | 0.217 | | |
| | 10 35 | 0009 | | | 1.0 |
| | 10 35 | 0015 | 0.223 | | |
| | 10 35 | 0035 | 0.223 | | |
| | 10 35 | 0055 | 0.226 | | |
| | 10 35 | 0080 | 0.231 | | |
| 75/07/09 | 11 30 | 0000 | 0.092 | 5.1 | |
| | 11 30 | 0005 | 0.107 | | |
| | 11 30 | 0015 | 0.101 | | |
| | 11 30 | 0035 | 0.132 | | |
| | 11 30 | 0055 | 0.148 | | |
| 75/11/07 | 09 50 | 0000 | 0.196 | 1.7 | |
| | 09 50 | 0005 | 0.181 | | |
| | 09 50 | 0015 | 0.184 | | |
| | 09 50 | 0035 | 0.189 | | |
| | 09 50 | 0068 | 0.189 | | |

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS
/TYPA/AMBNT/LAKE

320202
39 25 42.0 119 05 12.0 3
LAHONTAN RESERVOIR
32001 NEVADA
150191

11EPALES 04001002
0074 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/03/17 | 11 | 25 0000 | 6.3 | 10.4 | 33 | 224 | 8.10 | 88 | 0.020 | 0.200K | 0.590 | 0.188 |
| | 11 | 25 0005 | 6.7 | 10.4 | | 220 | 8.10 | 90 | 0.020 | 0.200K | 0.590 | 0.187 |
| | 11 | 25 0015 | 6.7 | 10.4 | | 225 | 8.10 | 92 | 0.030 | 0.200K | 0.600 | 0.212 |
| | 11 | 25 0035 | 6.7 | 10.6 | | 224 | 8.10 | 91 | 0.040 | 0.200K | 0.600 | 0.197 |
| | 11 | 25 0055 | 6.7 | 10.6 | | 224 | 8.00 | 93 | 0.040 | 0.200K | 0.600 | 0.198 |
| | 11 | 25 0070 | 6.2 | 10.4 | | 220 | 8.00 | 93 | 0.030 | 0.200K | 0.590 | 0.198 |
| 75/07/09 | 12 | 30 0000 | 22.5 | | 36 | 14 | 8.50 | 74 | 0.040 | 0.300 | 0.020 | 0.090 |
| | 12 | 30 0005 | 22.0 | 8.4 | | 14 | 8.50 | 77 | 0.040 | 0.300 | 0.020K | 0.089 |
| | 12 | 30 0015 | 19.0 | 7.8 | | 16 | 8.60 | 96 | 0.030 | 0.300 | 0.020K | 0.078 |
| | 12 | 30 0030 | 17.0 | 6.8 | | 16 | 8.60 | 87 | 0.040 | 0.300 | 0.060 | 0.092 |
| | 12 | 30 0050 | 16.0 | 6.0 | | 14 | 7.80 | 85 | 0.050 | 0.300 | 0.130 | 0.108 |
| | 12 | 30 0070 | 15.5 | 4.6 | | 12 | 7.70 | 75 | 0.030 | 0.300 | 0.190 | 0.161 |
| 75/11/07 | 09 | 25 0000 | 13.3 | 8.6 | 14 | 141 | 7.70 | 84 | 0.020K | 0.200 | 0.320 | 0.146 |
| | 09 | 25 0005 | 13.1 | 8.6 | | 141 | 7.70 | 86 | 0.020K | 0.200 | 0.310 | 0.145 |
| | 09 | 25 0015 | 13.1 | 8.2 | | 143 | 7.70 | 86 | 0.020K | 0.200 | 0.300 | 0.148 |
| | 09 | 25 0035 | 13.1 | 8.4 | | 141 | 7.70 | 86 | 0.020K | 0.200 | 0.310 | 0.127 |
| | 09 | 25 0058 | 12.9 | 7.4 | | 158 | 7.60 | 91 | 0.020K | 0.400 | 0.360 | 0.137 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/03/17 | 11 | 25 0000 | 0.222 | 2.5 | |
| | 11 | 25 0001 | | | 50.0 |
| | 11 | 25 0004 | | | 5.0 |
| | 11 | 25 0005 | 0.223 | | |
| | 11 | 25 0008 | | | 1.0 |
| | 11 | 25 0015 | 0.226 | | |
| | 11 | 25 0035 | 0.218 | | |
| | 11 | 25 0055 | 0.216 | | |
| | 11 | 25 0070 | 0.222 | | |
| 75/07/09 | 12 | 30 0000 | 0.123 | 6.8 | |
| | 12 | 30 0005 | 0.131 | | |
| | 12 | 30 0015 | 0.113 | | |
| | 12 | 30 0030 | 0.125 | | |
| | 12 | 30 0050 | 0.157 | | |
| | 12 | 30 0070 | 0.220 | | |
| 75/11/07 | 09 | 25 0000 | 0.196 | 1.3 | |
| | 09 | 25 0005 | 0.182 | | |
| | 09 | 25 0015 | 0.201 | | |
| | 09 | 25 0035 | 0.261 | | |
| | 09 | 25 0058 | 0.264 | | |

K VALUE KNOWN TO BE LESS THAN INDICATED

22

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320203
39 24 30.0 119 09 57.0 3
LAHONTAN RESERVOIR
32019 NEVADA
150191

/TYPA/AMHNT/LAKE

11EPALES 04001002
0047 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/03/17 | 12 00 | 0000 | 7.4 | 10.4 | 21 | 267 | 8.20 | 115 | 0.030 | 0.200K | 0.390 | 0.186 |
| | 12 00 | 0005 | 7.3 | 10.4 | | 267 | 8.25 | 123 | 0.030 | 0.200K | 0.380 | 0.186 |
| | 12 00 | 0015 | 7.1 | 10.4 | | 262 | 8.20 | 127 | 0.030 | 0.200K | 0.370 | 0.199 |
| | 12 00 | 0030 | 7.1 | 10.4 | | 271 | 8.20 | 116 | 0.030 | 0.200K | 0.370 | 0.177 |
| | 12 00 | 0043 | 7.1 | 10.4 | | 272 | 8.20 | 113 | 0.030 | 0.200K | 0.370 | 0.162 |
| 75/07/09 | 11 25 | 0000 | 22.0 | 8.0 | 36 | 18 | 8.30 | 80 | 0.040 | 0.300 | 0.030 | 0.090 |
| | 11 25 | 0005 | 20.0 | 7.4 | | 14 | 8.00 | 68 | 0.060 | 0.300 | 0.050 | 0.096 |
| | 11 25 | 0015 | 17.0 | 6.6 | | 12 | 7.70 | 68 | 0.060 | 0.200 | 0.090 | 0.104 |
| | 11 25 | 0030 | 15.0 | 5.8 | | 10 | 7.60 | 68 | 0.060 | 0.200 | 0.140 | 0.112 |
| 75/11/07 | 09 00 | 0000 | 12.5 | 8.2 | 11 | 163 | 7.70 | 85 | 0.020K | 0.200 | 0.340 | 0.150 |
| | 09 00 | 0005 | 12.5 | 8.2 | | 165 | 7.70 | 86 | 0.020K | 0.300 | 0.360 | 0.149 |
| | 09 00 | 0015 | 12.4 | 8.0 | | 165 | 7.70 | 89 | 0.020K | 0.300 | 0.360 | 0.150 |
| | 09 00 | 0030 | 12.2 | 8.2 | | 167 | 7.70 | 90 | 0.020K | 0.200 | 0.360 | 0.148 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/03/17 | 12 00 | 0000 | 0.208 | 4.7 | |
| | 12 00 | 0005 | 0.207 | | |
| | 12 00 | 0006 | | | 1.0 |
| | 12 00 | 0015 | 0.205 | | |
| | 12 00 | 0030 | 0.200 | | |
| | 12 00 | 0043 | 0.202 | | |
| 75/07/09 | 11 25 | 0000 | 0.138 | 3.0 | |
| | 11 25 | 0005 | 0.141 | | |
| | 11 25 | 0015 | 0.136 | | |
| | 11 25 | 0030 | 0.167 | | |
| 75/11/07 | 09 00 | 0000 | 0.212 | 2.2 | |
| | 09 00 | 0005 | 0.220 | | |
| | 09 00 | 0015 | 0.214 | | |
| | 09 00 | 0030 | 0.220 | | |

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320204
39 22 07.0 119 08 40.0 3
LAMONTAN RESERVOIR
32019 NEVADA

150191

/TYPA/AMBNT/LAKE

11EPALES 04001002
0017 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/03/17 | 12 45 | 0000 | 8.4 | 10.4 | 24 | 327 | 8.70 | 104 | 0.020 | 0.400 | 0.040 | 0.126 |
| | 12 45 | 0005 | 8.1 | 10.0 | | 327 | 8.70 | 113 | 0.020 | 0.400 | 0.050 | 0.126 |
| | 12 45 | 0015 | 8.0 | 10.4 | | 327 | 8.65 | 105 | 0.030 | 0.300 | 0.080 | 0.121 |
| 75/07/09 | 14 00 | 0000 | 24.0 | 7.0 | 28 | 8 | 8.40 | 63 | 0.050 | 0.400 | 0.030 | 0.089 |
| | 14 00 | 0005 | 22.0 | 6.8 | | 7 | 8.00 | 62 | 0.070 | 0.300 | 0.040 | 0.088 |
| | 14 00 | 0015 | 18.0 | 5.8 | | 6 | 7.60 | 61 | 0.110 | 0.400 | 0.100 | 0.097 |
| | 14 00 | 0025 | 17.0 | 5.2 | | 5 | 7.50 | 54 | 0.080 | 0.500 | 0.130 | 0.11[illegible] |
| 75/11/07 | 08 45 | 0000 | 11.7 | 9.4 | 11 | 169 | 7.80 | 90 | 0.020K | 0.200 | 0.120 | 0.120 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/03/17 | 12 45 | 0000 | 0.194 | 14.7 | |
| | 12 45 | 0001 | | | 50.0 |
| | 12 45 | 0004 | | | 5.0 |
| | 12 45 | 0005 | 0.183 | | |
| | 12 45 | 0007 | | | 1.0 |
| | 12 45 | 0015 | 0.188 | | |
| 75/07/09 | 14 00 | 0000 | 0.142 | 4.2 | |
| | 14 00 | 0005 | 0.143 | | |
| | 14 00 | 0015 | 0.160 | | |
| | 14 00 | 0025 | 0.290 | | |
| 75/11/07 | 08 45 | 0000 | 0.205 | 6.4 | |

K VALUE KNOWN TO BE LESS THAN INDICATED

# APPENDIX D

## TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 77/01/22
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

320201
39 27 50.0 119 03 35.0 4
CARSON RIVER
32 19 SILVER SPRNGS
O/LAHONTAN RESERVOIR 150191
SNP SAMP AT CAMPGRND BELO LAHONTAN DAM
11EPALES 04001004
0000 FEET DEPTH CLASS 00

/TYPA/AMBNT/STREAM

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/11/23 | 09 | 20 | 0.296 | 0.400 | 0.040 | 0.155 | 0.170 |
| 74/12/19 | 09 | 20 | 0.352 | 0.900 | 0.155 | 0.160 | 0.210 |
| 75/01/11 | 09 | 50 | 0.392 | 1.200 | 0.048 | 0.167 | 0.210 |
| 75/02/02 | 07 | 25 | 0.360 | 2.100 | 0.045 | 0.180 | 0.230 |
| 75/03/08 | 09 | 40 | 0.410 | 0.850 | 0.020 | 0.185 | 0.220 |
| 75/04/04 | 09 | 45 | 0.540 | 1.050 | 0.025 | 0.145 | 0.215 |
| 75/05/17 | 11 | 30 | 0.250 | 2.000 | 0.045 | 0.165 | 0.200 |
| 75/05/28 | 10 | 00 | 0.250 | 1.300 | 0.070 | | 0.160 |
| 75/06/06 | 14 | 11 | 0.185 | 1.250 | 0.077 | 0.160 | 0.180 |
| 75/06/22 | 13 | 15 | 0.095 | 0.550 | 0.010 | 0.115 | 0.170 |
| 75/07/12 | 11 | 10 | 0.140 | 0.500 | 0.035 | 0.115 | 0.180 |
| 75/08/10 | 11 | 10 | 0.095 | 0.400 | 0.040 | 0.115 | 0.210 |
| 75/09/13 | 11 | 40 | 0.115 | 0.400 | 0.005 | 0.115 | 0.170 |
| 75/11/22 | 15 | 00 | 0.300 | 0.500 | 0.030 | 0.150 | 0.220 |

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STORET RETRIEVAL DATE 77/01/22
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

/TYPE2/AM- T/ST-FA-

3202A2
39 17 40.0 119 15 03.0 4
CARSON RIVER
32 19 CHURCHILL BUTTE
T/LAHONTAN RESERVOIR 190191
BRDG ON US RT 95 .6 MI SE OF JCT HWY 28
11EPALES 04001004
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPT- FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/11/23 | 10 05 | | 0.144 | 0.300 | 0.020 | 0.195 | 0.200 |
| 74/12/19 | 10 00 | | 0.280 | 1.900 | 0.045 | 0.145 | 0.250 |
| 75/01/11 | 10 20 | | 0.416 | 1.700 | 0.144 | 0.190 | 0.300 |
| 75/02/02 | 09 53 | | 0.510 | 1.900 | 0.125 | 0.230 | 0.310 |
| 75/03/08 | 16 00 | | 0.410 | 0.950 | 0.020 | 0.185 | 0.310 |
| 75/04/04 | 10 20 | | 0.375 | 1.200 | 0.015 | 0.185 | 0.266 |
| 75/05/17 | 10 55 | | 0.180 | 2.100 | 0.190 | 0.075 | 0.600 |
| 75/05/28 | 13 00 | | 0.185 | 0.650 | 0.020 | 0.080 | 0.460 |
| 75/06/06 | 14 00 | | 0.055 | | 0.045 | 2.730 | |
| 75/06/22 | 15 00 | | 0.080 | 0.450 | 0.010 | 0.080 | 0.240 |
| 75/07/12 | 09 25 | | 0.115 | 0.550 | 0.035 | 0.180 | 0.190 |
| 75/08/10 | 10 45 | | 0.010 | 1.100 | 0.025 | 0.120 | 0.170 |
| 75/09/18 | 11 00 | | 0.020 | 0.300 | 0.005K | 0.135 | 0.160 |
| 75/11/22 | 14 30 | | 0.250 | 0.300 | 0.005 | 0.165 | 0.230 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 77/01/22
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

320281
39 28 10.0 119 03 50.0 4
TRUCKEE CANAL
32 19 SILVER SPRNGS
O/LAHONTAN RESERVOIR 150191
RECD ON US RT 50 .3 MI N OF LAHONTAN DAM
11EPALES 04001004
0000 FEET DEPTH CLASS 00

/TYPE/A/MOT/STREAM

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2+NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/11/23 | 09 | 32 | 0.442 | 0.700 | 0.110 | 0.220 | 0.220 |
| 74/12/19 | 09 | 05 | 0.552 | 2.400 | 0.230 | 0.240 | 0.270 |
| 75/01/11 | 09 | 40 | 0.605 | 1.900 | 0.284 | 0.220 | 0.340 |
| 75/02/02 | 09 | 15 | 0.375 | 0.800 | 0.300 | 0.220 | 0.310 |
| 75/03/08 | 09 | 15 | 0.575 | 2.700 | 0.130 | 0.210 | 0.270 |
| 75/04/04 | 09 | 35 | 0.010 | 0.900 | 0.010 | 0.120 | 0.246 |
| 75/05/17 | 11 | 40 | 0.055 | 0.300 | 0.020 | 0.050 | 0.040 |
| 75/05/28 | 13 | 20 | 0.050 | 0.250 | 0.025 | | 0.080 |
| 75/06/06 | 14 | 30 | 0.015 | 0.443 | 0.005 | 0.176 | 0.215 |
| 75/06/22 | 18 | 55 | 0.230 | 0.550 | 0.005 | 0.115 | 0.170 |
| 75/07/12 | 11 | 07 | 0.017 | 0.500 | 0.015 | 0.145 | 0.240 |
| 75/08/10 | 11 | 15 | 0.280 | 1.300 | 0.020 | 0.115 | 0.210 |
| 75/09/13 | 11 | 40 | 0.150 | 0.700 | 0.012 | 0.200 | 0.360 |
| 75/11/22 | 15 | 10 | 0.010 | 1.700 | 0.010 | 0.105 | 0.190 |

STORET RETRIEVAL DATE 77/01/22
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3202C1
39 06 15.0 119 23 00.0 4
UNNAMED CREEK
32 15 COMO
T/LAHONTAN RESERVOIR 150191
RD XING 4 M NW OF JCT W RD IN GLGHER PAS
11EPALES 04001004
0000 FEET DEPTH CLASS 00

/TYPA/AMBNT/STREAM

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 75/03/08 | 10 35 | | 0.900 | 1.300 | 0.035 | 0.430 | 0.480 |
| 75/04/04 | 11 10 | | 0.850 | 1.950 | 0.020 | 0.360 | 0.396 |

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# APPENDIX E

## PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1975

## STATE OF NEVADA

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of Nevada lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in μg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P |
|---|---|---|---|---|---|---|---|
| 3201 | LAKE MEAD | 0.016 | 0.340 | 266.565 | 3.111 | 11.400 | 0.005 |
| 3202 | LAHONTAN RESERVOIR | 0.198 | 0.350 | 472.083 | 4.608 | 10.400 | 0.148 |
| 3204 | RYE PATCH RESERVOIR | 0.094 | 0.050 | 467.750 | 4.938 | 10.000 | 0.039 |
| 3205 | LAKE TAHOE | 0.005 | 0.040 | -3.269 | 0.571 | 10.200 | 0.003 |
| 3206 | TOPAZ RESERVOIR | 0.057 | 0.165 | 376.000 | 7.517 | 14.600 | 0.041 |
| 3207 | UPPER PAHRANGAT LAKE | 0.173 | 0.125 | 470.000 | --- | 8.600 | 0.026 |
| 3208 | WASHOE LAKE | 0.403 | 0.130 | 494.555 | 11.633 | 7.200 | 0.268 |
| 3209 | WILD HORSE RESERVOIR | 0.114 | 0.320 | 489.400 | 75.530 | 14.600 | 0.065 |
| 3210 | WILSON RESERVOIR | 0.049 | 0.120 | 197.333 | 10.033 | 11.400 | 0.016 |
| 3211 | WALKER LAKE | 0.602 | 0.080 | 405.333 | 3.422 | 15.000 | 0.574 |

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P |
|---|---|---|---|---|---|---|---|
| 3201 | LAKE MEAD | 89 ( 8) | 11 ( 1) | 78 ( 7) | 88 ( 7) | 39 ( 3) | 89 ( 8) |
| 3202 | LAHONTAN RESERVOIR | 22 ( 2) | 0 ( 0) | 22 ( 2) | 63 ( 5) | 56 ( 5) | 22 ( 2) |
| 3204 | RYE PATCH RESERVOIR | 56 ( 5) | 89 ( 8) | 44 ( 4) | 50 ( 4) | 78 ( 7) | 56 ( 5) |
| 3205 | LAKE TAHOE | 100 ( 9) | 100 ( 9) | 100 ( 9) | 100 ( 8) | 67 ( 6) | 100 ( 9) |
| 3206 | TOPAZ RESERVOIR | 67 ( 6) | 33 ( 3) | 67 ( 6) | 38 ( 3) | 17 ( 1) | 44 ( 4) |
| 3207 | UPPER PAHRANAGAT LAKE | 33 ( 3) | 56 ( 5) | 33 ( 3) | --- | 89 ( 8) | 67 ( 6) |
| 3208 | WASHOE LAKE | 11 ( 1) | 44 ( 4) | 0 ( 0) | 13 ( 1) | 100 ( 9) | 11 ( 1) |
| 3209 | WILD HORSE RESERVOIR | 44 ( 4) | 22 ( 2) | 11 ( 1) | 0 ( 0) | 17 ( 1) | 33 ( 3) |
| 3210 | WILSON RESERVOIR | 78 ( 7) | 67 ( 6) | 89 ( 8) | 25 ( 2) | 39 ( 3) | 78 ( 7) |
| 3211 | WALKER LAKE | 0 ( 0) | 78 ( 7) | 56 ( 5) | 75 ( 6) | 0 ( 0) | 0 ( 0) |